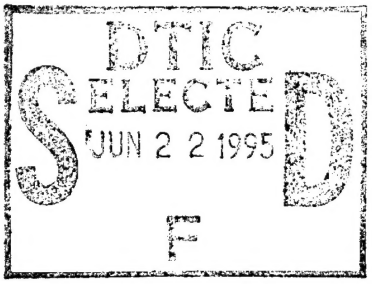
C & C TECHNOLOGIES, INC.



A TECHNICAL REPORT

on

PHASE 2: SEA TRIALS RESULTS

for

NRL CONTRACT N00014-94-C-6005

SEPTEMBER 30, 1994

Approved for public release;
distribution is unlimited.

GENERAL

Sea Lion #1 has been mechanically reconfigured and refurbished in order to make the vehicle sea worthy and capable of meeting NRL's needs as a research and development platform. The hull has been extended by 16 inches and the electronics bay modified to improve payload capacity. These modifications included the lowering of the fore planes and splitting the fuel into two compartments. The nose cone was also modified for easy access and removal for sensor installation and maintenance.

Sea Lion #1 was also electrically refurbished in order to insure the vehicle is fully functional and operationally sound. Some sensors were upgraded and the entire electrical system checked, refurbished and calibrated.

PURPOSE

The intent of the Sea Trials was to determine the overall state of readiness of the vehicle. This step was necessary at this point of the program to preclude the possibility of causing damage or loss of sensors to be integrated into the Sea Lion. Primary concerns included the effect of hull modifications on vehicle performance and the effectiveness of the hatch seals.

RESULTS

DAY 1:

The Sea Lion was taken to the Port of Iberia for initial testing. The Vehicle was lowered into the water with the engine and electronics bay hatches off to observe for leaks. No leaks were evident. The vehicle was then lifted out of the water so that the nose cone area and electronics compartment could be loaded with sand bags and metal weights to emulate the anticipated weight distribution of the completed Sea Lion sensor suite. The hatches were closed and the vehicle lowered to the water once again. The center of gravity was observed and deemed acceptable. The air vents were then opened and the ballast areas flooded to observe the vehicle for positive bouancy. Positive bouancy was good. A blow was then manually initiated and vehicle performance observed. The blow was successful. A small air leak was detected in the nose cone gasket.

LESSONS LEARNED

1. The leak in the nose cone gasket was due to the use of contact cement on one side of the gasket. Good quality gasket sealer must be applied to both sides.

2. The lift sling made for Sea Lion #1 was designed with a thimble to allow for adjustments in determining center of gravity. This sling did not work because it did not lock into position. A chain harness was used and adjusted to determine the proper lengths of the legs. A new sling has been obtained.

3. The fuel bag compartments did not have vent holes to allow for full flooding. Holes have been drilled near the top of the fuel bag compartments.

DAY 2

The Sea Lion was mobilized to Cameron, Louisiana. The topside control electronics were installed in the CAPT. BLAKE (a 35' Lafite skiff). The CAPT. BLAKE was used as the mother ship for the trials.

DAY 3

0700 hrs began preparations for launch of the Sea Lion. Pre-dive checklist was accomplished and the vehicle launched at approximately 0930 hrs. Vehicle could not dive. The control console indicated no depth feedback. Received a low pressure air alarm and the control system indicated that the low pressure air was off. Returned to port and removed vehicle from water approximately 1200 hrs.

Began trouble shooting depth sensor systems. Vehicle could not dive without depth feedback. An obstruction was discovered in the hose leading to the depth sensor near the forward bulkhead. Repairs were made and the depth sensor was tested. The low pressure air sensor was replaced and tested. The 'low pressure on' indication was received on the console.

DAY 4

0700 hrs began preparations for launch. Pre-dive checklist was accomplished and the vehicle launched at approximately 0930 hrs. The vehicle was submerged and surfaced several time during transit in the channel to insure the dive problem was fixed. No problems noted. Proceeded to approximately 5 miles off shore to attain sufficient water depth (30 feet). The Sea Lion was then taken to a depth of three meters. Performed various control maneuvers for several hours. Maneuvers included surface, stop, dive and turns up to and including 180 degrees. The turns were done both manually and through the control computer. The video card for the control monitor was deteriorating. The screen was periodically refreshed to clear excessive clutter.

The Sea Lion speed was too slow for the engine rpms. The vehicle was running at 6 knts with an engine speed of 2000 rpm. The vehicle should have been running at about 10 knts at 2000 rpm. We were still experiencing problems with low pressure air alarms although the low pressure was good.

Returned to port at approximately 1730 hrs. The screw was replaced with a higher pitch screw. Attempts were made to locate spare EGA cards for the video display. So far no luck.

DAY 5

0700 hrs began preparations for launch. Pre-dive checklist was accomplished and the vehicle launched at approximately 0930 hrs. The vehicle was submerged at three meters and run to the same location as the previous day. On the way out the speed vs rpm was observed. The vehicle speed was 12 knts at 2200 rpm and engine temperature was 88 degrees centigrade. The vehicle could not attain maximum rpm, 2500 rpm. Began receiving 'low charge current' alarms. At 1130 hrs the engine died and the vehicle surfaced. Repeated attempts to start engine failed. The Mast valve and fuel valve were not opening. At 1250 hrs began towing the Sea Lion back to port. Towing speed was approximately 4 knts. Arrived at port at 1615 hrs.

Trouble shot the problem and isolated it to a bad engine over temperature switch. No spare switch was available. The decision was made to wire around the switch and closely monitor engine temperature. The engine over temperature switch shuts down the mast valve and fuel valve solenoids.

DAY 6

0700 hrs began preparations for launch. Pre-dive checklist was accomplished and the vehicle launched at approximately 0905 hrs. Low charge current alarms still occurring. NAVO personnel were onboard the CAPT BLAKE to observe the Sea Lion. Various maneuvers were performed to demonstrate the vehicle capability. Maneuvers included rise, dive, stop, and turns of up to 180 degrees. An emergency blow occurred at about 1330 hrs. It was later determined to be due to an electronic flood alarm. The blow was shut off in time to reserve 500 pounds of air. The decision was made to continue operations. The vehicle speed vs rpm was tested again. The vehicle speed was approximately 12 knts at 2275 rpm. The vehicle performed well for the remainder of the day. Engine temperature remained constant at 87~88 degrees centigrade. Arrived at port at 1630 hrs.

Checked the electronics compartment for water and found a small amount. A small hole was discovered in the electronics compartment hatch gasket on the port side. Attempted to seal the hole with silicone sealer. No spare gaskets were available.

Trouble shot the charging current sensor. A bad connector was causing the problem. No spare connectors were available so the cable was cut and spliced.

A crack in the forward blow line was also discovered. The crack did not leak at the time but was noted for replacement later. When refiling the air tanks a leak developed in the charge air check valve. The O ring was found bad and replaced.

DAY 7

0700 hrs began preparations for launch. Pre-dive checklist was accomplished. A second hole was discovered during the pre-dive inspection of the electronics hatch seal. The decision was

made to continue and launch the vehicle. The vehicle was launched at 0945 hrs. The vehicle was again brought to 5 miles off shore. During operation an electronic compartment flood alarm occurred and the vehicle surfaced with a full blow. The blow was shut off and sufficient air remained. All systems checked O K and operations resumed. A salt water leak through the windshield of the CAPT BLAKE disrupted the control radio link and the vehicle again surfaced without a blow. The cramped conditions of the vessel required the removal of the control system from the rack. This put the control radio next to the windshield. The connector was repaired and operations resumed. A second electronics compartment flood alarm was received and the vehicle surfaced again with a full blow. This blow exhausted the remaining air supply. The decision was made to return to port and discontinue operations. After some consideration the decision was made to run the vehicle on the surface under its own power rather than tow the vehicle. Arrived at port at 1300 hrs. Began preparations to mobilize to Lafayette.

LESSONS LEARNED

1. The electronics bay hatch did not fit properly. The cover had to be forced down over the gasket to engage the hatch dog bolts and did not hinge like the engine hatch. FIX- Have a new hatch cover rolled and position the hatch dogs for hinged operation. Called Bollinger Shipyard to have the same done to Sea Lion #2.

2. Seals are very critical. Need to assign one person responsible for inspection, cleaning and closing the hatches. FIX- Mr. Richards is assigned this task. Also need to stress to all who work on the Sea Lion use caution around the seals.

3. The hinged mast O-ring seal was machined on the upper mast fitting. Needs to be changed to be on the lower fitting to keep the O-ring in place when raising the mast. FIX- Bollinger Shipyard made the changes and made Sea Lion #2's mast O-ring on the bottom fitting.

4. The nose cone had to be removed several times during trouble shooting. No spare gasket was available. This was very time consuming in caring for and cleaning the gasket. FIX- Spare nose cone gaskets will be made and be part of a critical spares kit along with gasket sealer.

5. The following hardware is needed to make handling the Sea Lions more user friendly:
    a. Tow rings.
    b. Launch and retrieval rings.
    c Permanent boarding ladders for the trailers.
    d. A canopy to keep the electronics bay in the shade and protect from rain during pre-dive and maintenance.
    e. A cover for the screw to avoid head injuries.
    f. Change sump hose to a PVC pipe.
    g. Modify trailer to reduce tongue weight and lengthen tongue.

7. We did not have sufficient spares during these trials. A critical spares list will be developed

and coordinated with NRL.

SUMMARY

The Sea Lion performed well during these sea trials. It proved to be a very stable platform in the conditions experienced during the trials (worst case 3 to 5 foot seas). While submerged the vehicle had virtually no visible roll, pitch or heave. The vehicle operated for approximately 24 hours during the sea trials. The vehicle surfaced four times during this period due to malfunctions. The fail safe systems work very well and all problems have been identified/repaired or fix actions initiated. None of the problems were unexpected nor significant enough to cause doubts in the Sea Lion's readiness and capability. The decision was made to continue with the integration and installation of the SIMRAD EM 950 and other supporting sensors.

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